UNITED PLANTERS' ASSOCIATION OF
SOUTHERN INDIA

SCIENTIFIC DEPARTMENT

(TEA SECTION)

ANNUAL ADMINISTRATION REPORT

FOR

1952–1953

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3 SEP 1953

NOTE :

Specimens for laboratory examination should be sent by *unregistered* parcel post to

The Officer-in-Charge,
U.P.A.S.I. Tea Experiment Station,
Devarshola P. O.,
Nilgiris.

In the case of specimens too bulky to send by post, they should be sent by rail to Ootacamund and the Rail Receipts or Parcel Way Bills sent to

The Rajalakshmi Motor-Service,
Ootacamund,

for collection and forwarding to Devarshola.

UNITED PLANTERS' ASSOCIATION OF
SOUTHERN INDIA

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1952–1953

LIST OF CONTENTS

	Page
Report of the Chief Scientific Officer	1
Meteorological Data	12
Report of the Asst. Scientific Officer and Entomologist ...	13
Report of the Soil Chemist	21
Report of the Botanist	27
Appendices	33

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SCIENTIFIC DEPARTMENT

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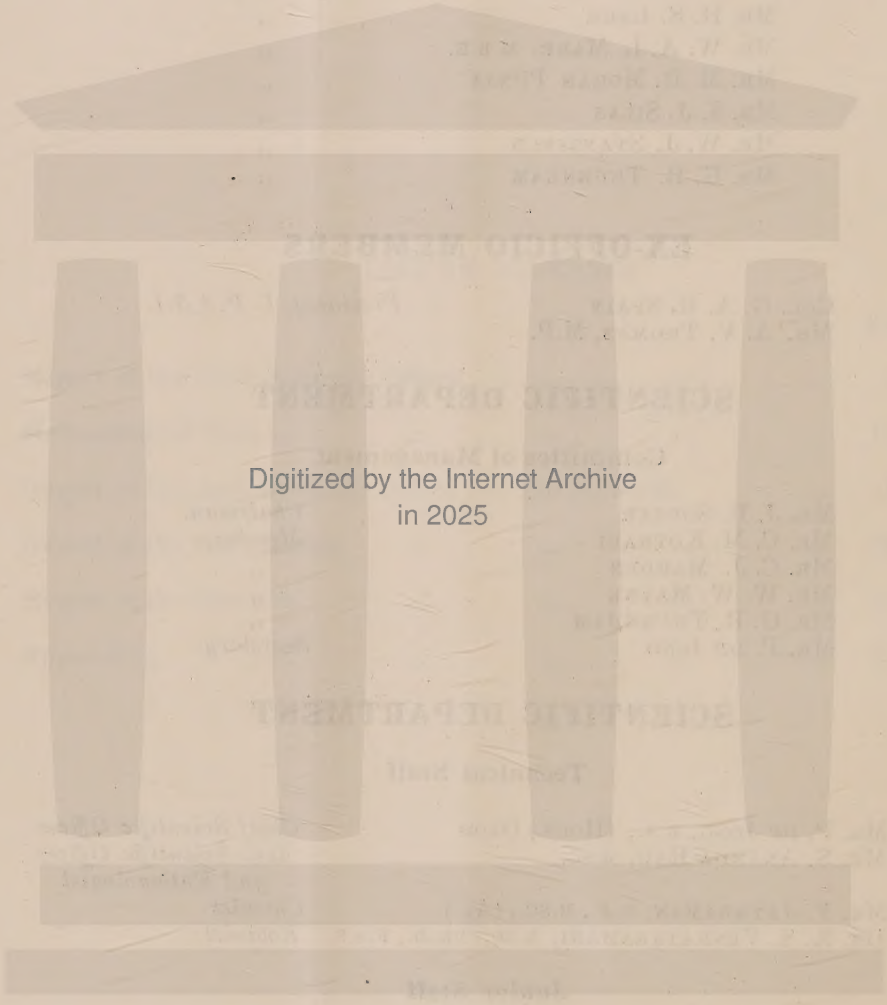

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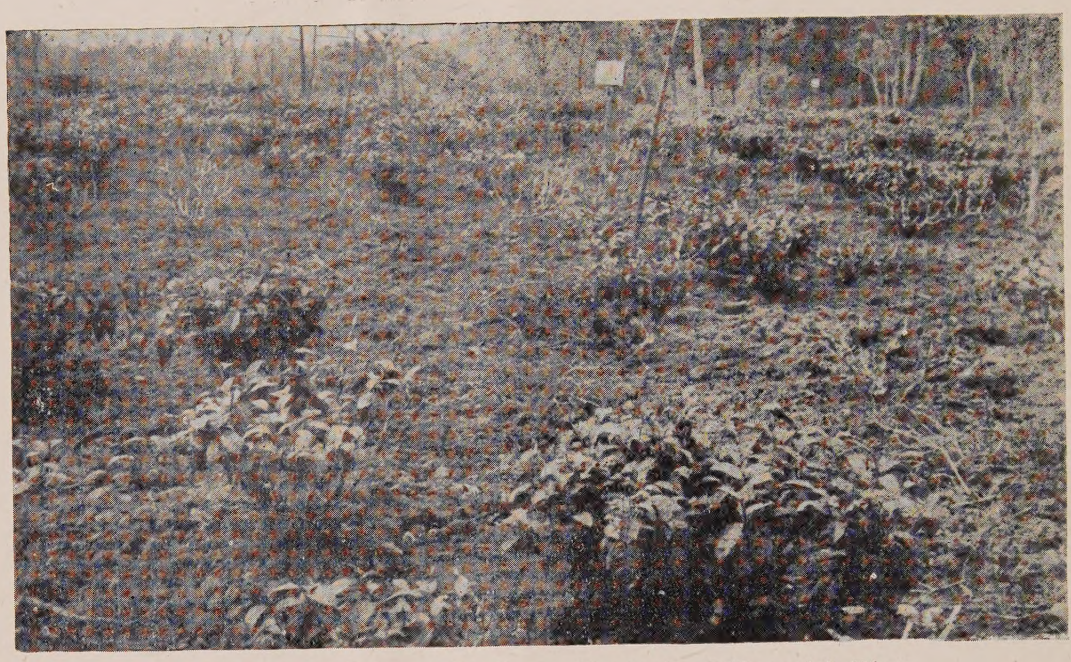


PLATE I. U. P. A. S. I. Expt. Station. Typical 'O Potash' Plot.

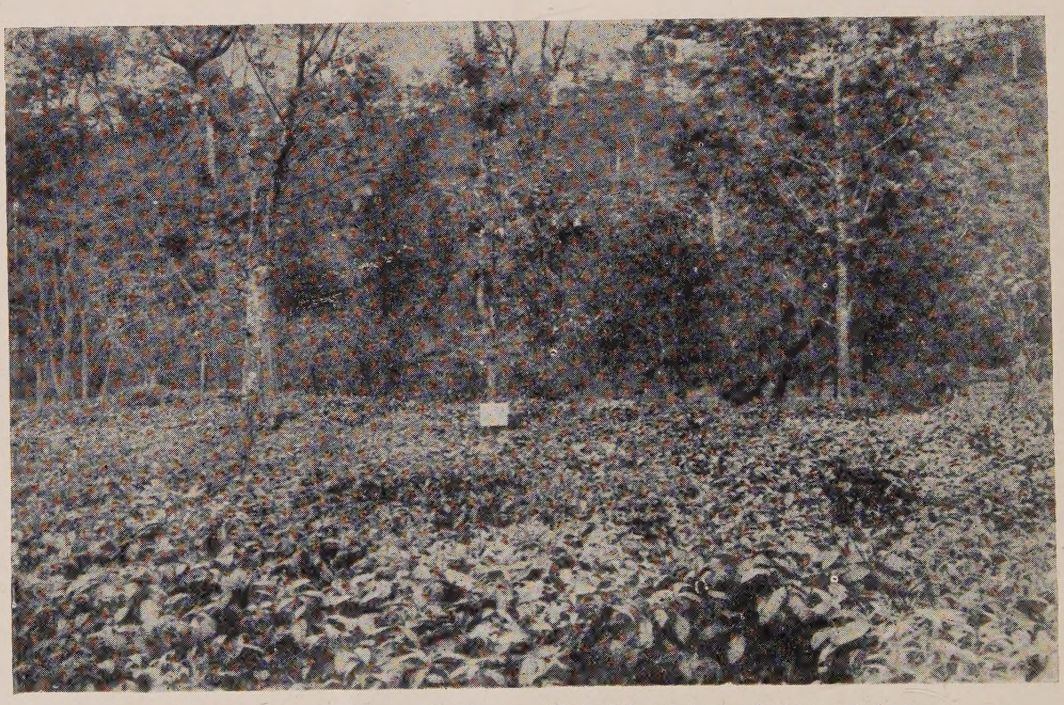


PLATE II. U. P. A. S. I. Expt. Station. Neighbouring plot receiving full dose of NPK fertiliser mixture.

United Planters' Association of Southern India

Annual Report of the U.P.A.S.I. Scientific Department

TEA SECTION

For 1st April 1952—31st March 1953.

REPORT OF THE CHIEF SCIENTIFIC OFFICER

PART I—ADMINISTRATION.

As in previous years the Chief Scientific Officer retained his headquarters at "Glenview", Coonoor. Mr. C. S. S. Rao, Clerk to the Chief Scientific Officer at Coonoor, resigned his appointment with effect from the 26th of March 1953, and Mr. D. Arunachalam, formerly of the U. P. A. S. I. Labour Department, Palamcottah, was appointed in his stead.

There were no changes in the technical staff of the Department and the Assistant Scientific Officer continued to act as Officer-in-Charge, U. P. A. S. I. Experiment Station, Devarshola.

Once again it is a pleasure to note that the volume of advisory correspondence continued to increase throughout the year both in Coonoor and at Devarshola. Administrative correspondence too was on the increase and in Coonoor monthly receipts and despatches averaged nearly 150 letters each, while at Devarshola during the period 875 letters were received and 908 despatched.

U. P. A. S. I. Tea Experiment Station, Devarshola : The area of the Tea Experiment Station at Devarshola remains the same as in previous years, namely 13.8 acres planted in tea and 13.2 acres comprising roads, buildings, fuel clearings and uncultivated areas. A small seed nursery of Dangri Manipuri seed was put down in December 1952 and the plants will be used for supplying up and replanting some of the existing tea areas.

During the year normal maintenance of the Laboratory and Store buildings, staff and labour accommodation, was undertaken. A service connection for electric power to the Laboratory was eventually given in July 1952, but owing to restriction on the consumption of electricity later in the year it has not been found possible to obtain the full benefit from this installation.

It is very rare that reference to past annual reports does not disclose some mention of deficiency in rainfall at Devarshola, or the occurrence during any particular year of a long drought, but this year has been marked for a particularly grave deficiency in rainfall, only 48.97″ of rain being recorded during the year. Only on one previous occasion has a lower total rainfall been recorded at Devarshola, namely in 1934-35 when 46.98″ were measured, but in

the preceeding year the rainfall had exceeded 116", so the effect of this low rainfall was not as marked as that at present experienced. During the last 10 years, 7 of them have been noted for rainfalls of less than 70" and though distribution rather than total rainfall is the important factor, there is no doubt that the cumulative effect of light South-West Monsoon rains and almost complete failure of North-East Monsoon rains is having a serious effect on ground water-tables and on soil moisture. Both wells at the Experiment Station dried up in February 1953 and are not likely to start to run fully before July. This has meant serious interference with Laboratory work owing to complete lack of running water and during the next year a new water-scheme is to be put into operation at the Experiment Station.

Once again, in spite of the limiting factor of climate, a satisfactory crop of green leaf was harvested, and 59,038 lbs. of green leaf were sold to our landlords, Woodbriar Estate Ltd., at a figure of 4 annas per pound, realising a sum of Rs. 14,759/8/-. Based on an average outturn of 23 per cent, this quantity of green leaf represents a yield of 984 lbs. of made tea per acre. Although lower than the record figure of 1,111 lbs. obtained during 1951-52, this yield, in view of the adverse climatic conditions, is considered most satisfactory and is once again in my opinion an illustration of the benefit of the increased Nitrogen applications now being given to the tea. The monthly crop figures are given as an Appendix to this report.

Scientific Sub Committee: During the year the Scientific Sub Committee was replaced by a Scientific Department Committee of Management consisting of the Chairman, Tea Product Section Committee ; the South Indian representatives on the Central Tea Board, Messrs. C. M. Kothari, C. J. Madden and G. R. Thurnham ; Mr. W. Wilson Mayne, and the Chief Scientific Officer. This Commitree was constituted after the meeting of the Tea Product Section Committee on the 27th August 1952 and met in Coonoor on 10th November 1952, and 16th March 1953.

Research Expansion Sub Committee: Proposals for the expansion of the Scientific Department having been drawn up and submitted to the Central Tea Board during the year, the duties of the Research Expansion Sub Committee were transferred to the Scientific Department Committee of Management. A full scheme for the expansion of the Scientific Department was drawn up and submitted by the Tea Section Committee to the Central Tea Board and formed the basis of discussion between this Association, the Central Tea Board, and the Ministry of Commerce and Industry, Government of India. A grant of approximately 7½ lakhs of rupees for implementing these plans was made by the Central Tea Board, but final sanction of the scheme by the Government has been withheld pending reconsideration of general policy after the constitution of the new Central Tea Board.

Publications: Once again a series of notes and articles were published in the bi-monthly issues of *The Planters' Chronicle*, and a list of these publications is given as an Appendix to this report.

Touring: During the year tours and liaison visits were paid to most districts in South India by members of the Scientific Department Technical Staff. A list of such tours appears in Appendix III.

In addition to local touring the Chief Scientific Officer paid a visit to North-East India in December 1952, when he attended the Tenth Annual Scientific Conference of the Indian Tea Association Scientific Department at Tocklai. Once again visits were paid to tea areas in the Upper Assam Valley. On the conclusion of this tour, the Chief Scientific Officer proceeded to Delhi on local leave, during which time a number of visits were paid to various Government departments and matters relating to Government policy with regard to crop protection materials and equipment and research policy were discussed.

In March 1953 the Chief Scientific Officer visited Ceylon to attend the Biennial Conference of the Tea Research Institute, Ceylon, held at Nuwara Eliya.

U. P. A. S. I. Scientific Conference and Exhibition: As in previous years, "Planters' Week" included an exhibition and Scientific Conference. This year the Scientific Department's stall at the exhibition was designed to be of general interest and the nature of the exhibits attracted considerable attention.

The Scientific Conference, which this year took the form of symposium on "The Weed Problem in Coffee, Tea and Rubber Plantations" was well attended and a series of papers were presented by the Director of Research, Indian Coffee Board, the Rubber Production Commissioner, Indian Rubber Board, Mr. P. M. Glover, Indian Tea Association, Scientific Department, Tocklai, and the Chief Scientific Officer, U. P. A. S. I. All these papers were subsequently published in *The Planters' Chronicle.*

First Annual Conference—U. P. A. S. I. Scientific Department.—The first Annual Conference of the Scientific Department was held at "Glenview", on the 18th March 1953. It was attended by 7 delegates representing various South Indian District Planters' Associations, and a large number of visitors. Papers were presented on "Some aspects of the work of the Botanical Section of the Tea Experiment Station", by Dr. Venkataramani, "The Problem of Red Spider in South India" by Mr. Ananda Rau, and "Some Notes on the Manuring of Tea under present day conditions" by the Chief Scientific Officer, and a large number of questions submitted by delegates were discussed. A full report of the Proceedings has been published as UPASI Scientific Department Bulletin No. 11.

Boards and Committees: The Chief Scientific Officer continued to represent the Association on the Board of the Indian Council of Agricultural Research, Crops and Soil Wing and on the Nilgiri District Soil Conservation Board, the regular meetings of which were all attended.

Visitors: During the year a number of visitors were received at the Tea Experiment Station at Devarshola and at the office of the Scientific Department at Glenview, Coonoor. We were particularly pleased to welcome Mr. A. D. Khan, Chairman, and Mr. K. D. Guha, Secretary, Central Tea Board, Mr. M. Lury, Pest Control (United Kingdom) Ltd., Mr. G. W. Severn, Technical Director, Horlicks Ltd, Mr. W. R. Nickson, Plant Protection Ltd., Dr. F. L. Wellman, Inter-American Institute of Agr. Sciences, Costa Rica and Dr. W. H. Cowgill, Instituto Agropecuario Nacional, Guatemala City.

Part II — Research and Advisory.

As in previous years the emphasis of the work of the Department has been on advisory matters, and much of the time of the technical staff of the Department has been taken up in dealing with correspondence relating to local problems.

The Blister Blight investigations carried out in previous years were this year followed up by a large scale experiment designed to assess the relative values of dusting and spraying in protecting tea recovering from pruning, and this experiment will be reported on in full later in this section. During this year the emphasis appears to have moved from the Mycology Section to both the Entomology and Chemistry Sections with the growing importance of mite attacks on tea, in particular those of the Red Spider Mite and with the conclusion of the 12th year of the 27th plot factorial manuring experiment which has now run for 4 consecutive three year pruning cycles.

The work of the various sections, Entomology, Chemistry, Botany and Mycology, will be described in detail in the reports of the respective heads of the sections, but it is desirable at this stage to make a brief reference to some of the work carried out by the individual sections and the Department as a whole.

Entomology Section

As in previous years the main insect pest of tea in South India is the Tea Mosquito Bug (*Helopeltis theivora*) but during the year attention has been to a great extent focussed on attacks by various forms of mites especially Red Spider Mite and the Purple Mite.

In previous years passing reference has been made to these pests and it has always been acknowledged that attacks by mites were to be expected on tea in South India during periods of dry weather. In the Annual Report for 1951-52 reference was made to the apparent increase in the severity of attacks by Red Spider and Purple Mites on tea in Central and South Travancore, and the possibility of a build-up of mites resulting from the widespread use of chlorinated hydrocarbon insecticides for the control of certain insect pests, notably *Helopeltis*, was suggested. During a visit to Central and South Travancore by the Chief Scientific Officer in 1952 and on a subsequent occasion, however, a striking degree of correlation between attacks of Red Spider and Purple Mites and treatments with copper fungicides for the control of Blister Blight of tea were noted. References to workers in the United States of America (Prof. A. M. Boyce, Citrus Experiment Station, Riverside, California, and Dr. Francine E. Fisher, Citrus Experiment Station, Lake Alfred, Florida; personal communications) confirmed that build-up of mites on Citrus is not an uncommon feature following treatment with copper and other fungicides used to control certain fungus diseases.

Large areas of tea in South India are now being treated with repeated applications of copper fungicides to control Blister Blight and other leaf and stem diseases of tea and it is most important that a careful check is kept on this situation lest an even more difficult problem in the shape of heavy infestations of mites should arise. The Entomology Section are currently investigating a number of acaricides which show promise for the control of various mites, but the problem is complicated by the fact that most of the materials satisfactory for mite control possess properties which render tea manufactured from treated leaf very liable to taint.

During the process of screening the above mentioned acaricides, opportunity was taken to determine the possible degree of taint from a new organic fungicide NIRIT and two new insecticidal formulations, a dust and spray, based on LINDANE the 99/100% *gamma* isomer of Benzene Hexachloride, an allegedly non-tainting form.

NIRIT applied at a concentration of 0.5% had no effect on the quality of made tea according to tasters' reports and it now remains to assess the value of the product from the point of view of fungicidal efficiency.

INEXIT DUST CONCENTRATE, containing 20 % LINDANE and INEXIT WETTABLE POWDER, containing 25% LINDANE supplied by CELA G. M. B. H. Inglehein am Rhein, was applied as recommended, namely 1 lb. of dust concentrate let down with 29 lbs. of inert filler and applied at the rate of 30 lbs. per acre and a 0.1% LINDANE spray applied at the standard rate of 50 gallons per acre. In both cases tea manufactured from leaf plucked 8 days after treatment was reported upon as being badly tainted, while tea manufactured from leaf 23 days after treatment was still reported upon unfavourably by the tasters, the spray perhaps being more objectionable than the dust.

Mention is also made in the report of the Entomologist of severe attacks of Thrips in Central and South Travancore and also in the Nilgiris and Nilgiri-Wynaad. Here too the occurrence of this pest gives some reason for concern as at the time of writing it is now known that a recurrence of Thrips damage in Central and South Travancore on a possibly even greater scale has taken place.

Mycology Section

The report of the Botanist contains a number of references to Mycological problems investigated during the year. Red Rust is now widely evident in South India and is to be found on most debilitated tea. Where efforts are being made to rehabilitate such weak areas, the advisability of proper prophylactic spraying cannot be over emphasised.

Once again joint investigations in which all members of the Scientific Department Staff cooperated were undertaken into various aspects of Blister Blight Control.

With the assistance of the Management of Daverashola Estate, which is most gratefully acknowledged, field scale trials on the protection of tea recovering from pruning with copper sprays and dusts and the use of the Clean Crops Ltd. Micron Sprayer for the control of Blister Blight on tea in plucking were carried out.

Power Spraying of Tea.—A prototype Micron Sprayer designed by Clean Crops Ltd. and loaned to the Scientific Department by Shaw Wallace & Co. Ltd., Madras, was available for field trials during 1952. Two fields both in their second year of pruning were selected and spraying was carried out from a lorry moving along estate roads, the tea on both sides of the road being treated. Preliminary investigations determined the average swathe width of the machine to be approximately 80 ft. and on this basis the total area covered in both fields was approximately 30 acres. 45 gallons of spray liquid was found to be sufficient to cover this area and the actual time involved in spraying was 50 minutes. On the basis of these figures a lorry mounting a Micron Sprayer and moving at an average speed of 4 m. p. h. is able to cover one acre of tea in $1\frac{1}{2}$ minutes with $1\frac{1}{2}$ gallons of spray.

The spray mixture used was made by mixing $3\frac{3}{4}$ lb. of Copper Sandoz and 6 lbs. Euphytan Summer Oil in 30 gallons of water. Later, conversations with Mr. E. J. Bals of Clean Crops Ltd. resulted in the use of $7\frac{1}{2}$ lbs. of Copper Sandoz in every 30 gallons of water, which raised the rate of application to 6 oz. of Copper Sandoz per acre in an oil/water emulsion.

The trial started on the 18th June 1952 and continued up to the 28th October 1952, applications being made at weekly intervals. Towards the end of August and during September, when sunny weather prevailed and Blister Blight infection was at its lowest, spraying was suspended. In all 15 rounds of spraying were carried out during the entire period of the trial.

Field observations indicated that protection was adequate up to a distance of 60 ft. from the machine. For a further 20 ft. thinly scattered spary deposits could be observed on the leaf, but were not considered sufficient to give adequate protection and observations of intensity of infection bore out this surmise.

On one occasion colorimetric estimation of copper in made tea was carried out on leaf plucked 5 days after spraying, and two samples of fine bulk were found to contain 127. 5 and 150 p. p. m. Copper. However no rain had fallen during the period between spraying and plucking. At the time this estimation was made the field had received 11 rounds of spraying.

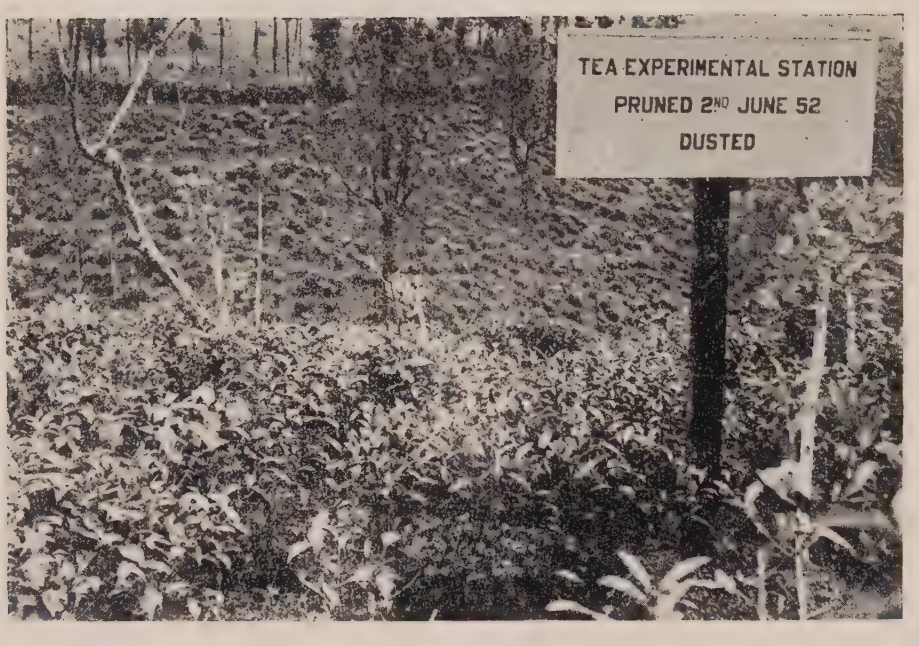
During the course of the trial spray applications with this oil/water emulsion were not at any time noticed to cause injury to the tender foliage of the tea.

Pruning and Protection Trial.—During 1951-52 a preliminary investigation into the relative values of copper containing sprays and dusts for protecting tea recovering from pruning from attack of Blister Blight was carried out at the UPASI Tea Experiment Station, and the conclusions arrived at are set out in the Annual Administration Report of the UPASI Scientific Department for 1951-52

During this year an extension of this investigation was carried out on a larger scale on Daverashola Estate. Commencing in June 1952 an area of tea of approximately 3/4 acre in extent was pruned during the first week of each successive month upto and including October. These areas were sub-divided into 3 equal plots, each approximately 1/4 acre in extent, in one of which the tea was protected by wet spraying, in one by dusting and the third retained as an untreated control plot. Applications of fungicide were commenced approximately 14 days after conclusion of each pruning operation and continued throughout the Blister Blight season which extend up to the first week of January 1953. A 50% wettable copper fungicide applied at the strength of 4 oz. in 10 gallons of water and at the rate of 16 gallons per acre was used for wet spraying. Dusting was done initially with Universal Crop Protection Ltd. Cuprosana 6% Copper Dust until tipping time and with Cuprosana 4% Copper Dust thereafter. The rate of application in both cases varying between 5 and 8 lbs. per acre. Rounds of spraying or dusting were carried out at 4 or 5 day intervals between commencement of the experiment and tipping and thereafter were extended to 8 to 10 day intervals.

PLATE III. Preservation of Bamboo nursery baskets.

PLATE IV. Sci. Dept. Blister Blight Expts.
1952 Pruning & Protection Trials.



PLATES V & VI. 1952 Season Pruning & Protection Trial.
Treated plots photographed on 9th September 1952.

As described in previous Annual Reports, the method of comparison of treatments was based on two series of observations designed to determine the percentage intensity of the attack over the whole treated area and the percentage shoot infection, which in this case was recorded on the basis of examination of 200 shoots taken at random from the flush from each plot at each plucking round.

In the following table the averages of these records are given for the individual treatments for each of the 5 pruning periods, and it can be observed from these figures. that though both spraying and dusting have given adequate protection, there is little to choose between them. Continuous observation of the experiment however definitely suggests that wet-spraying does give an apparently greater degree of control of the disease, though this may not in fact be of economic significance.

	Average % Intensity of Infection.			Average % Shoot infection		
	Control.	Sprayed	Dusted.	Control.	Sprayed	Dusted.
June Pruned	20.0	6.5	6.9	38.7	15.25	15.4
July ,,	13.8	4.6	8.9	30.0	11.0	20.1
August ,,	20.1	4.7	4.4	46.5	11.3	10.7
September ,,	6.6	1.9	1.8	10.1	4.2	4.5
October ,,	1.4	0.9	1.1	3.0	2.25	3.5

Averages based on observations made during the period
4th September 1952—13th January 1953

Throughout the period of the trial yield records were maintained for the individual areas. When these figures are corrected to account for variation in bush numbers, yields for the various treatment are as follows:—

Control	521	lbs. green leaf
Sprayed	1079	,,
Dusted	1070	,,

While it would not be right to place too much significance on these figures even though differences are so great, analysis of the figures for the individual months of pruning suggests most strongly that initial benefits derived from crop protection during early stages of recovery from pruning are maintained to a marked degree throughout the period.

Not only does this trial illustrate graphically the advantages of spraying or dusting for protecting tea recovering from pruning, it also brings out a number of interesting points regarding times of pruning themselves. Under

the conditions obtaining in the area during 1952 it seems that June pruning is to be preferred because more effective control of Blister Blight is obtained by spraying or dusting. In spite of crop protection measures, plots pruned during July have more infection in November than the plots pruned in the preceeding months.

August pruning appears liable to more severe Blister Blight attacks later in the year than either June or July pruning, but treatments can very effectively cope with the disease. September and October pruning have every chance of escaping severe attacks even without treatment.

Blister Blight Demonstration Plot in Central Travancore.—In order to provide a visual demonstration of the effects of protective measures in the control of Blister Blight, 3 plots each 1/4 acre in size were laid down on Arnakal Estate in Central Travancore, in an area of tea some 6 months from pruning and which, owing to its situation, was subject to very favourable conditions for disease attack. One plot was dusted with Cuprosana 4% dust at the rate of 10 lbs. per acre and another sprayed with Perenox at 4 oz. in 10 gallons of water applied at the rate of 15 gallons per acre. The third plot was left untreated as a control. Applications of spray and dust were made at 7 day intervals and from reports received and personal observations made during visits to the District later in 1952, the differences noted between the treated plots and the control were indeed spectacular.

Botany Section.

The work of the Botany Section is to a considerable degree handicapped owing to the preoccupation of the Botanist with Mycological problems, as a result of which insufficient time is available for concentration on such important matters as weed-control and plant breeding.

As far as time and availability of materials permitted, weed-control experiments carried out in previous years were developed with particular reference to the use of Sodium TCA in young tea.

Work started in previous years on the soil moisture status of tea areas in relation to shade cover has been continued and is providing information of considerable interest.

In co-operation with the management of Brooklands Estate, a small scale field trial with the Tarpen Mechanical Plucker was started in April 1952 and continued up to March 1953 when difficulty experienced with the Mechanical Pluckers made it necessary to discontinue the trial.

Two areas of tea each approximately $\frac{1}{4}$ acre in extent were marked out in a uniform field which had been pruned late in 1951. One plot was plucked by hand and one plot by machine from April 1952 after tipping had been completed. By the end of March 1953 the following figures relating to both plots were available for comparison. In the case of the mechanically plucked plot, 15 rounds of plucking had been carried out through the year, a total of 230 lbs. of green leaf being harvested for the cost of $17\frac{1}{2}$ man hours and 2 gallons of petrol. Of the 230 lbs. of green leaf, however, 89 lbs. of coarse leaf, stalk, etc., had to be discarded as unsuitable for manufacture, leaving only 141 lbs. of leaf suitable for transport to the factory.

In the case of the hand plucked plot 19 rounds of plucking had yielded 361 lbs. of green leaf at the cost of 43 women hours.

The trial was entirely carried out by the labour and management of Brooklands Estate and after instruction had been given on the method of employing the mechanical plucker, no further technical assistance or direction was given. Throughout the year the machine continued to operate quite efficiently, though as previously stated, in April 1953 it became unserviceable and required major overhaul. The condition of the tea under mechanical plucking did not visibly deteriorate and at the end of the year looked to all intents and purposes as clean and well maintained as the hand plucked area. There is no doubt the unsatisfactory yield figures in this experiment from the mechanically plucked area may to some extent be due to the very slow growth rate experienced in Coonoor during the year, largely as a result of the extremely serious drought experienced during the period. Naturally the influence of climate has also been felt on the hand plucked plot, but it is considered that under more favourable climatic conditions and with more rapid growth rate, the mechanically plucked tea might have grown into plucking more rapidly with the consequent reduction in the amount of coarse leaf harvested on each occasion.

A new pattern Tarpen Plucker with certain improvements both in respect of the power unit and the cutting head was received early in 1953, but we were unable to take this machine into use owing to certain mechanical defects.

Chemistry Section

During the year the 27 plot factorial manuring experiment at the UPASI Tea Experiment Station concluded its 12th consecutive year and on the figures of four pruning cycles becoming available we were able to make some preliminary statements regarding certain aspects of the manuring of tea in South India, with particular reference to the Nilgiri-Wynaad.

A short account of this experiment has already been given in the paper "Some Notes on the Manuring of Tea in South India" presented at the UPASI Scientific Department Annual Conference, and reproduced in the UPASI Scientific Department Bulletin No. 11.

During the year the industry faced a period of crisis largely due to recession in tea prices and rising costs of production. The industry became acutely aware of need for economies and on a number of occasions the Scientific Department was asked for advice as to how best manuring costs could be reduced.

Consideration of the results of the 12 year manuring experiment pointed out very clearly that reduction of Nitrogen applications to tea would result in decreasing crop yields and even more marked, that the reduction or elimination of Potash from fertiliser mixtures would undoubtedly have a harmful effect on the tea, even though this might not become apparent for some time. On the other hand experimental evidence suggested most strongly that during the course of 12 years, applications of Phosphates had had no effect on the yield of tea whatsoever nor had they apparently had any effect on the tea's capacity to make use of either Nitrogen or Potash. For this reason, therefore, and as a temporary measure of economy, the Scientific Department recommended that where necessary Phosphates could be omitted from manure mixtures, rather than see economies effected by reduction in applications of Nitrogen or Potash.

This policy, however, must be accepted with reserve, as although 12 years experience has indicated that the absence of Phosphates have had no adverse effects on the tea, it is possible that long term effects may develop if Phosphates are withheld for indefinite periods and this aspect is receiving the consideration of the Scientific Department.

It is hoped to publish a full account of the experiment and the results obtained during the course of next year.

In cooperation with the managements of Mayfield, Deverashola and Craigmore Estates, manurial experiments to assess the value of high rates of application of a soil amendment mixture consisting of 700 lbs. of Rock Phosphate and 100 lbs. of Muriate of Potash have been continud, and the figures at the end of the first year are given in the report of the Soil Chemist. While it is much too early to comment on this experiment, it is interesting to note that the results from the three widely separated experiments are giving precisely similar indications, suggesting that the figures eventually to be obtained will be of considerable reliability.

General

During the year a small trial was started to assess the value of certain plastic materials as linings for tea containers. Alkathene, supplied by Imperial Chemical Industries (India) Ltd., and Pliofilm supplied by the Goodyear Tyre & Rubber Co. (India) Ltd. were used during the investigations, results of which have been published in the *Planters' Chronicle* for 15th May 1953. Briefly, the trials disclosed that neither Alkathene nor Pliofilm lined chests appeared as satisfactory as those lined in the usual manner with Aluminium foil and tissue paper: the report of the tea tasters usually being critical of those teas from chests lined in any way save in the conventional manner.

Acknowledgements

During the year the Scientific Department has received a considerable measure of assistance from the Secretariat of the UPASI, and from other sections of the South Indian Planting Industry; in particular, I should like to mention the members of the Tea Product Section Committee, the Scientific and Research Expansion Sub Committees, which were later replaced by the Scientific Department Committee of Management. On behalf of my colleagues and myself I should like to acknowledge with gratitude the assistance of the Director and Staff of the Tea Research Institute of Ceylon, and the Director and Staff of the Indian Tea Association, Scientific Department, Tocklai, with whom our Department maintains an extremely useful measure of contact, and all the other institutions and departments who have helped us from time to time during this year.

Once again we are indebted to a large number of commercial interests for the preparation and supply of a variety of plant protection formulations and equipment and for the supply of fertiliser mixtures for certain field experiments.

I should like to acknowledge with much gratitude the cooperation of the Agents and Managers of Estates in the conduct of field experiments and particularly those who have shown all of us such great hospitality during the year.

In conclusion I must again pay tribute to the energetic and enthusiastic assistance from my colleagues, and all members of the Scientific Department Staff whose efforts have assisted to a considerable degree in the running of the Department during the year; in particular, I should like to mention Mr. C.S.S. Rao, whose ability and efficiency in my office at "Glenview", were of great personal assistance to me, and whose resignation from this Association creates a *lacuna* difficult to fill.

PETER DE JONG,
Chief Scientific Officer.

METEOROLOGICAL

(1952–53)

Months	Rainfall in inches	No. of days with rain	Air		Soil*		Humidity		Vapour Pressure		Cloud	
			Average noon maximum	Average Overnight minimum	8.30 A. M.	3.00 P. M.	8.30 A. M.	3.00 P. M.	8.30 A. M.	3.00 P. M.	8.30 A. M.	3.00 P. M.
April 1952	2.11	13	85.2	65.1	83.1	89.8	86.1	62.3	23.6	23.1	7.3	5.5
May ,,	3.51	11	81.9	66.9	82.6	87.8	87.6	69.0	23.8	23.9	6.7	5.8
June ,,	8.96	28	75.3	64.9	74.8	78.0	89.8	87.3	21.8	22.8	6.1	6.9
July ,,	9.89	27	74.5	64.4	73.7	76.4	92.7	84.5	21.7	22.5	6.0	6.4
August ,,	10.41	30	74.1	64.6	73.1	75.6	93.5	89.1	21.5	23.4	6.6	6.4
September ,,	2.12	13	77.1	63.6	75.2	80.4	85.2	71.9	20.3	21.3	7.1	5.1
October ,,	10.31	20	76.3	65.0	73.9	77.3	90.8	80.8	21.5	22.3	6.9	6.0
November ,,	0.32	1	79.0	59.5	73.8	77.3	86.4	60.1	18.9	19.1	6.0	4.0
December ,,	1.34	6	76.9	60.0	71.2	74.2	92.9	60.6	18.9	17.5	6.4	6.4
January 1953	...	...	80.8	58.2	72.7	76.2	85.8	46.2	16.6	15.3	6.6	5.8
February ,,	...	...	83.1	59.0	74.7	80.0	79.3	32.1	16.2	11.6	4.0	...
March ,,	...	...	88.4	63.3	82.0	89.7	86.9	37.4	21.1	15.5	...	4.0
Total ...	48.97	149										

* at 1 foot depth.

The period has been marked by an extremely low total rainfall, the lowest recorded at the Experiment Station except for the year 1934-35. The low rainfall this year is the direct result of a very light South West Monsoon followed by the now regular failure of the North East Monsoon. The usual unusual weather has again proved to be more unusual than usual.

Report of the Asst. Scientific Officer and Entomologist

(1952—1953).

Administration

The Assistant Scientific Officer was in charge of the Devarshola Tea Experiment Station throughout the year except for a month in February/March 1953 when, during his absence on annual leave, the Soil Chemist was in charge.

The direction and supervision of the work of the Station continued, as usual, to be exercised by the Chief Scientific Officer, who made periodic visits to the Station.

Correspondence

Letters received and despatched at the Station numbered 875 and 908 respectively, these figures being very nearly the same as in 1951/52. 293 technical enquiries were received and dealt with during the year.

Touring

Appendix III gives details of the touring carried out during the year. Some of the tours were undertaken mainly for investigations in furtherance of the research programme of the Department, while others were liaison tours made in order to keep in touch with the prevailing conditions in the different tea districts and for advisory purposes.

Visitors

In May 1952, members of the Research Expansion Sub-Committee met at the Station where a meeting had been convened.

In August 1952, the Chairman and Secretary of the Central Tea Board paid a visit to the Station.

The Station received throughout the year a large number of technical representatives of various firms dealing in fertilisers and plant protection equipment and formulations.

Publications

A paper dealing with the problem of Red Spider in South India was contributed to the Scientific Conference held in March 1953, the proceedings of which have been published in Bulletin No. 11 of the Department.

Entomological

Advisory

As in past years, the Department was called upon from time to time to identify pests and advise on control measures for dealing with them. With few exceptions, the enquiries related to minor pests of sporadic occurrence which were of no more than local importance. A notable exception was the widespred damage to tea by thrips in several districts during the hot weather of 1952, to which reference will be made later in the report.

Helopeltis

During the year under review, several reports were received that, in spite of intensive and efficient dusting, quite severe attacks of *Helopeltis* were being experienced and this had led to the suspicion that a new strain of the insect, immune to DDT, was developing. Following one such report, a visit was made to South Travancore where the question of the possible resistance of Helopeltis to DDT was thoroughly investigated. Several toxicity trials carried out on the spot gave results in conformity with those obtained in previous years and there was no reason to suppose that the insect was acquiring any sort of resistance.

On looking into other causes for the failure of dusting to control the pest, several points came to light and in view of their general importance to Estates carrying out dusting, it may be useful to mention them here.

It transpired that no regular schedule of applications or timings was being followed and that the fields were dusted on a sort of 'as and when necessary' basis after the onset of the monsoon. While this procedure is now quite adequate in areas subject to late and comparatively light attacks, such as parts of Central Travancore, it would appear that for conditions obtaining in South Travancore the omission of pre-monsoon dusting is fraught with serious consequences, in that any build-up of the pest which may take place during the monsoon months would be extremely difficult to control. This point has been specifically stressed in this Department's Annual Report for 1948/49 (p. 10, para 4).

It was further learnt that dusting had been carried out at application rates of 3, 5 and 10 lbs. per acre per round and that although 2 and 3 rounds of dusting had been done on some fields, the pest was still persisting. When a general spread of the pest has taken place, the above rates of application, in our opinion, are too low to produce effective control, especially during the monsoon months when substantial quantities of dust are liable to be washed down by rain. A rate in the neighbourhood of 18/20 lbs. is required to secure adequate control.

In addition to the above, a few other points were also discovered as contributing to the reduced effectiveness of dusting. These were: (1) reduced strength of DDT in the DDT/china clay mixture used, (2) dusting in wet weather with the attendant risk of the dust being washed down by rain and (3) incorrect application technique.

In Central Travancore, although some quarters are inclined to the view that more frequent dustings than before are necessary, the general opinion appears to be that there is no positive evidence of control breaking down. This question is one which calls for the greatest vigilance both by the Scientific Department and the Estates concerned, especially as similar, though unconfirmed, reports of declining efficiency of DDT applications have recently come in from Indonesia.

In view of the difficulty of satisfactorily supervising the mixing of the dust locally, a few Estates in Central Travancore are understood to favour the use of ready-mixed dusts available in the market. This change-over is certainly welcome from the point of view of insecticidal efficiency and the cost of the ready-mixed dust relative to the home-made dust is the only point against it.

Red Spider

The increased prevalence of Red Spider prompted the beginning of an investigation into this problem. It seems fairly clear that, sooner or later, Red Spider in South India will reach a stage when chemical control measures have seriously to be considered for combating the pest. In order to be prepared for this, work was devoted to screening a number of acaricides (chemicals which kill mites, of which Red Spider is one), with a view ultimately to select an acaricide which is suitable for the points of both lack of taint in made tea and efficiency in killing Red Spider in all its stages. As a first step, a trial with various acaricides was undertaken during the year to determine which of them are satisfactory from the point of view of lack of taint in made tea. The spray applications were made on small plots of tea on High Wavys Group where facilities were available for manufacturing tea from very small quantities of green leaf. The following acaricides, at the concentrations noted against them, were tried :—

1.	Ovotran[1]	1%
2.	Aramite-15W[2]	2.5%
3.	Spersul[3]	1%
4.	Thiovit[4] (with Sandovit[5] 0.1%)	1%
5.	„ („ 0.2%)	0.5%
6.	„ („ 0.1%)	0.5%
7.	Euphytan[6]	1%
8.	Fernasul[7]	2.5%
9.	Whiz Summer Insecticide[8] ...	1.25%
10.	Sofril[9]	0.75%
11.	Ultra Sulphur[10]	0.3%

The sprays were applied at an application rate of 50 gallons per acre in all cases and two rounds were done with an interval of 8 days between them.

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1. A wettable powder containing 50% of the active ingredient : p—chlorophenyl p—chlorobenzenesulfonate, previously known as K 6451, supplied by The Dow Chemical Co., Midland, Michigan.
2. 15% Betachloroethyl beta (p—tertiarybutyl—phenoxy)—alphamethylethylsulfite, supplied by the United States Rubber Company, Connecticut.
3. A dispersible powder containing 73% of sulphur as active ingredient, supplied by I.C.I. (India) Ltd.
4. A sulphur preparation (Sandoz product) supplied by Shaw Wallace & Co.
5. A Wetting agent (Sandoz product) supplied by Shaw Wallace & Co.
6. A mineral oil (Sandoz product) supplied by Shaw Wallace & Co.
7. A lime-sulphur preparation containing 25.28% polysulphide sulphur, supplied by I. C. I. (India) Ltd.
8. A mineral oil spray preparation supplied by John Paterson & Co. (India) Ltd.
9. A wettable sulphur preparation supplied by Geigy Insecticides, Ltd.
10. A colloidal sulphur spray containing 50% elemental sulphur, supplied by Geigy Insecticides, Ltd.

The crop harvested 8 days after the first application and 8 and 23 days after the second application was rolled separately on Pizey miniature rollers and manufactured separately. Samples of teas so made were submitted for taster's opinion regarding taint.

The taster's report indicated that most of the teas manufactured from leaf plucked 8 days after treatment were tainted, either in liquor or in infusion or in both, while in a few cases opinion was undecided. The only sample which was judged as being free from taint was that of leaf from bushes treated with Euphytan. Samples of teas made from leaves plucked 23 days after the second treatment were generally reported as untainted, except in the case of the Ovotran treated sample wherein the taint was stated to persist in both liquor and infusion.

The above trial serves to indicate that the question of taint could be overcome in the case of at least a few acaricides provided a reasonable time is allowed to elapse between spraying and plucking. What this time should be is a matter for further investigation. Trials with some compounds have to be repeated and tests are also contemplated with a few new formulations which have since been received. During the coming year, it is hoped to screen for acaricidal efficiency such of the formulations as have given, or do give, promising results in the tainting tests.

The visit to Central Travancore made in November 1952 provided an opportunity to examine closely the Red Spider situation in that district. Although the attack, in general, has not yet reached the stage of warranting control measures, there was little doubt that the pest was on the increase. On one estate visited, more than 50% of the bushes were found attacked, thus indicating the need for undertaking control measures.

No clear-cut evidence was forthcoming during the visit to correlate the prevalence of Red Spider with DDT dusting which is being carried on throughout the district for the control of *Helopeltis*. In a few instances, however, there were definite indications of a build-up of Red Spider in fields treated with copper fungicides against Blister Blight.

Red Spider formed the subject of a paper contributed to the Scientific Conference held in March 1953. In that paper our present knowledge of the pest, its status as a pest in South India, the factors which are most likely to have brought about its increase and the lines along which work is proposed to be undertaken towards controlling the pest have been discused.

Purple Mite

This ubiquitous pest of tea is also becoming more and more prevalent in all the tea districts of South India. Its maximum activity is limited to a short period during the dry weather and it is difficult to estimate the extent of damage caused by it. It undoubtedly aggravates drought damage and in many areas of tea delay in active growth resumption, even after favourable weather sets in, is probably to be attributed to this pest.

Small scale field trials with two new acaricide formulations, G-22914 and G-24353, kindly supplied by Geigy Insecticides Ltd., were carried out on an estate in the Nilgiris where Purple Mite attack is severe. G-22914 sprayed at

two strengths (1 in 1000 and 1 in 500) produced satisfactory kills of the mite, the mortality obtained with the higher strength being almost 100%. The effect of the spray, however, did not last very long, as a second examination of leaf samples collected a fortnight after spraying revealed that a build-up of mites had taken place in all plots, with hardly any difference between plots of the lower strength and control and only a slight difference in favour of plots sprayed at the higher strength.

G-24353 also produced promising results. In indoor trials, even as low a concentration as 1 in 2000 was found to be toxic to the mite. Tocklai also report that their laboratory trial with this product (dilution not stated) gave 100% kill of active forms and a high percentage mortality of quiescent stages and eggs of Red Spider. Its residual toxicity has not yet been determined.

Eriophyes carinatus is the scientific name by which the Purple Mite of tea is known so far, but doubt is now expressed about the correctness of this name. Dr. H. H. Keifer of the California Department of Agriculture, who has considerable experience in the systematics of Eriophyid mites, considers that our tea Purple Mite is probably a species of *Calacarus*. Arrangements are being made to send him specimens in order to get his confirmation of the identification.

Thrips

Several reports of damage to young tea flush by thrips during the hot weather of 1952 were received almost simultaneously from Central and South Travancore. Thrips damage to tea coming in from pruning was particularly prominent and widespread in the Nilgiri-Wynaad District in October/November 1952. Whether the insects occurring in the different districts belong to one and the same species is yet to be determined.

Dendrothrips bispinosus is the species of thrips which has been known for a long time to attack tea in the Nilgiris. Except on some high elevation estates, thrips were not hitherto considered to be troublesome, but reports received and observations made during the year would appear to indicate that the incidence of thrips on estates, even at lower elevations, can cause considerable damage. In one instance which came to notice. it was reported that nearly 300 acres of tea were affected and although loss of crop is difficult to estimate, it was considered that at least 25% of the crop was lost from the worst affected areas.

As this insect was hitherto of comparative unimportance, its habits and life-history have not been studied and are little understood so far. It appears as though thrips would present another problem which has to be tackled in future years. Should attacks become more general than now, control measures would be called for, to devise which a full knowledge of the pest is essential. For the time being, application of DDT, either as a wet spray or as a dust, is being recommended and one estate which has carried out this treatment has reported it to be effective.

Dadap "Ringer"

This beetle was particularly prevalent during the year and was the cause of considerable damage to both old and newly planted Dadaps in the Nilgiri-Wynaad. In addition to Dadaps, the beetle was also found to ring the branches of *Gliricidia*. References to this pest have been made in earlier Annual Reports

and it need only be mentioned here that this is a type of pest which is not amenable to any chemical method of control so far tried and the destruction by burning of all rung branches which harbour the immature stages of the insect is the only remedy.

Other minor pests which were reported during the year included the following:—stem borers (*Phassus* sp. and *Zeuzera coffeae*), lobster caterpillar (*Stauropus alternus*), red slug flushworm (*Cydia* (*Laspeyresia*) *leucostoma*), tea aphis (*Toxoptera aurantii*), termites, rats and eelworm (*Meloidogyne* (*Heterodera*) *marioni*) on tea and *Argina* spp. on Crotalarias.

General

Rot-Proofing of Nursery Baskets

In order to prevent bamboo nursery baskets from being damaged by termites, and fungi especially if the tea plants are to be left in baskets in the nursery for about 18 months, it is essential that the baskets should be treated with some suitable preservative. A small scale trial was undertaken on the Station with different preservatives, using 10 baskets for each treatment. The preservatives used were the following:—

1.	Copper sulphate	5%
2.	Copper sulphate	10%
3.	Copper naphthenate	2.5%
4.	Santobrite [1]	2%
5.	Santobrite	1%
6.	Cuprinol [2]	neat
7.	Ovicide [3]	5%
8.	Agrosan GN [4]	4 oz. in 2½ glns. water.
9.	Fernasan [5]	,, ,,

The ten baskets under each treatment were treated with the above preparations and an additional 10 baskets were kept untreated as control. The treatment consisted of dipping the baskets for 5 minutes in all the preparations except 3 and 6 which, as the quantity available was limited, were sprayed on to the baskets both inside and out. Agrosan GN and Fernasan did not make satisfactory solutions or suspensions in water, in spite of pre-mixing with a small quantity of alcohol and the treatments with these two preparations must therefore be regarded as unsatisfactory. All the baskets after treatment were filled with soil, a tea seedling put in each and left in the open in the nursery.

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1. Technical Sodium Pentachlorophenate, supplied by Monsanto Chemicals Ltd.
2. Supplied by Jenson & Nicholson.
3. A tar oil miscible wash supplied by I. C. I. (India) Ltd.
4. A preparation of organo-mercurial salts containing an equivalent of 1% mercury, supplied by I. C. I. (India) Ltd.
5. A non-mercurial organic seed dressing containing tetramethylthiuram disulphide (TMTD), supplied by I. C. I. (India) Ltd.

The first examination made 6 months after treatment indicated that the control baskets had more or less completely disintegrated, while those treated with copper compounds remained intact. Treatments with Ovicide, Agrosan GN and Fernasan were less satisfactory and the baskets had partially disintegrated. Final examination at the end of 11 months disclosed that except baskets treated with the copper compounds, all the others had completely disintegrated. The 4 copper compounds were of the following descending order of effectivness.

1.	Copper sulphate	...	10%
2.	Copper naphthenate	...	2.5%
3.	Cuprinol	...	neat
4.	Copper sulphate	...	5%

The first two were considered to be more or less of equal effectiveness and the baskets treated with them were in a good state of preservation, both at the sides and at the bottom. The baskets of the last two treatments revealed only slight disintegration of the sides but almost complete disintegration of the bottom. Even so, they were not considered unfit for being transported to the field prior to planting out. (Plate III)

Use of Agrocide on Tea Nursery Beds

An instance of a heavy application of Agrocide (P520) on nursery beds resulting in failure of the nursery, came under notice during the year. The application was made ostensibly with the idea of eliminating soil and other insect pests such as crickets, cutworms, etc., from nursery beds and also perhaps as a precaution against the root-knot eelworm which is the most common source of trouble in nurseries. The germinated tea seed was put out on the beds almost immediately after the latter were treated with Agrocide, with the result that the tender radicle of the germinated seed was poisoned, became "clubbed" at the tip and ceased to grow any further. Even after three months the smell of benzene hexachloride was persisting in the vicinity of the nursery, in spite of the beds being watered frequently during the dry weather. It was feared that the beds could not be used again for some considerable time extending perhaps to one or two years.

While Agrocide is useful in the control of insect pests like crickets and cutworms, the use of the 50% concentrate as such is dangerous on a tea nursery. A dust with a low concentration of BHC, such as Gammexane D. 025, which contains only 5% BHC or 0.65% of the *gamma* isomer, is more suited for use in nurseries. Against root-knot eelworm, Agrocide has been found to be ineffective (*vide* Annual Report 1947–48 pp. 9-10).

Use of Seed Dressings

In a half-maund tea nursery raised on the Station during the year, the use of a few seed dressings was given a trial which fully confirmed the results of an earlier trial which showed that the treatment of tea seed with Tillex (a Sandoz product containing 1.5% mercury) and Fernasan (a non-mercurial organic preparation produced by Plant Protection, Ltd.) hastens germination. Full details of this trial are to be found in the Botanist's Repost.

Acknowledgements

It is a pleasure to record appreciation of the co-operation and help received from the Managers of Estates in the conduct of field experiments. My special thanks are due to Mr. R. W. Thorpe of the High Wavys Group who provided all facilities for carrying out the tainting tests and arranged for the tea samples to be tasted and reported on; also to Mr. M. G. Raghava Menon, Manager, Terrace Estate, without whose help the field trials with the acaricides on Purple Mite would not have been possible.

The hospitality received from Managers of estates visited during the year is gratefully acknowledged.

S. Ananda Rau,

Asst. Scientific Officer & Entomologist.

Report of the Soil Chemist

(1952—1953)

Advisory

The following samples were analysed and reported on in connection with advisory work.

Soils	89
Composts and Cattle manure	3
Manures and Manure Mixtures	24
Tea Factory Ash	1
Tea Waste	1
Lime	1
DDT in DDT/China Clay Mixtures	12
Synthetic rice	1
Copper in Copper sulphate, in made tea and in fungicides	9

Enquiries regarding the use of urea as a substitute for sulphate of ammonia in manure mixtures, the use of activators in composting, manuring pruned areas. methods of increasing soil acidity and manuring young tea were attended to.

Manures

All the manures and manure mixtures analysed conformed to the guaranteed analysis given by the suppliers. In some mixtures, the phosphoric acid content was very much higher than the guaranteed figure, owing to the phosphatic manure containing considerably higher percentages of phosphoric acid than the accepted figures.

In order to study the extent of absorption of moisture by manure mixtures containing varying percentages of urea, a small scale trial was started during the year. The mixtures consisted of (1) urea and groundnut cake, (2) urea and flour phosphate and (3) urea and steamed bone meal. The percentages of urea in each series were 10, 15, 20, 25 and 30 % by weight. Immediately after the mixtures were made, the moisture content in the individual manures and mixed samples was determined. The mixtures, 2 lb. by weight of each, held in small closed gunny bags were stored in the laboratory cupboard. Monthly determinations of moisture contents were made on these samples. The figures obtained from November 1952 to March 1953 indicate a slight increase of moisture in groundnut cake mixtures but not in the other two. Even so, the physical consistency of the groundnut cake-urea mixtures was satisfactory. The weather was very dry during this period with very low relative humidity. The determinations will be continued.

Although urea contains a high percentage of nitrogen and in terms of unit cost is cheaper at present than sulphate of ammonia, because of its tendency to absorb atmospheric moisture quickly and to render the mixture sticky and therefore difficult of application, it does not seem advisable to incorporate more than 20 % of urea by weight in manure mixtures. Even at Devarshola with the first showers of rain and a consequent increase in the relative humidity of

the atmosphere, a mixture containing ammonium sulphate, urea, steamed bone-meal and muriate of potash became wet and sticky. Probably 10 to 15 % of urea together with ammonium sulphate and groundnut cake would be a more desirable proportion.

Soils

A large number of the samples analysed were those from prospective nursery sites.

Estimations of organic carbon in soils from shaded and unshaded areas on the Station were made periodically and the figures are referred to in the report of the Botanist. The percentage of organic matter was calculated by multiplying the carbon figure by the conventional factor 1.72.

Soil samples collected from the soil amendment trials on Mayfield and Davershola Estates were analysed for nitrogen, organic matter, calcium, phosphoric acid and potash (total and available) and reaction. The estimations of exchangeable bases have been taken on hand. Samples from these areas will be analysed at regular intervals throughout the trial to find the changes resulting from the different treatments.

It is proposed to analyse during the ensuing year, the soils from the Station 27-plot factorial experiment which has completed 12 years continuous artificial manuring with ammonium sulphate, superphosphate and muriate of potash.

It will be interesting to record here an instance of a tea soil containing 1.48 % and 1.53 % CaO in the top and bottom layers respectively. Such high figures are very exceptional. The CaO content of most tea soils lies between 0.1 % and 0.4 % and in a few cases reaches 0.5 %. The soils referred to above were rich in nitrogen, phosphoric acid and potash and the poorness of the stand of tea was clearly attributable to the high calcium content.

To study the effect of a single large application of lime to mature tea, a small area on the Station was divided into two plots to one of which slaked lime at the rate of 5 tons per acre was applied broadcast and forked in during December 1952. Estimation of total and exchangeable calcium and pH were made before application. In another trial involving five bushes, slaked lime was applied at the rate of 1, 2, 3, 4 and 5 lbs. per bush during November 1952.

Field Experiments

The yield data for the field experiments are tabulated below.

Plant Food Requirements

A. 27 Plot (3 x 3 x 3) Factorial Experiment.

Tea Experiment Station. This experiment completed its fourth cycle during the year. The yield figures for the last year of the cycle are as follows:-

TABLE I.

Nitrogen	0 lbs.	40 lbs.	80 lbs.
Yield	951.9	1032.3	1425.6 lbs. made tea/acre
Phos. Acid	0 lbs.	20 lbs.	40 lbs.
Yield	1114.5	1170.3	1125.0 „ „
Potash	0 lbs.	20 lbs.	40 lbs.
Yield	780.3	1220.1	1409.4 „ „

Difference required for significance:

P = 0.05 = 310.5 lbs. Made Tea.
P = 0.01 = 470.4 lbs. „

40 lbs. application of nitrogen has not resulted in any significant increase in yield, while the double dose—80 lbs.—has continued to give a significant increase.

However, although the 40 lbs. application has not shown any increase which is statistically significant, it must be noted that throughout the conduct of the experiment, this rate of application has always resulted in a yield higher than that from the 0 lbs. plots, indicating the probability of response by the tea to these applications, though at a level which the layout of the experiment makes it impossible to detect with statistical accuracy.

Phosphoric acid has not shown any effect on the yield since the inception of the trial.

Both single and doule doses of potash have, as in the previous year, resulted in significant increases in yield, the former at 5 % and the latter at 1 % levels.

The results and conclusions from this experiment have been given briefly by the Chief Scientific Officer in his paper "Some Notes on the Manuring of Tea Under Present Day Conditions" (Proceedings of the First Annual Conference, 1953, U. P. A. S. I. Scientific Department (Tea Section) Bulletin No. 11) and it is intended to publish a full account of the experiments elsewhere.

B. 25 plot (5 x 5 Randomised Block) Experiment.

High Range (Kanniamallay, Munnar, Letchmi, and Nullatanni).

TABLE *2.*

Yield in Lbs. Made Tea per Acre.

	O	N	NP	NK	NPK	Difference required for significance.
Nullatanni	442	485	540	459	576	212.2
Munnar	820	1000	960	1100	1087	136.1
Kanniamallay	1496	1554	1585	1581	1494	166.6
Letchmi	291	239	229	336	475	118.8

On Munnar, the treatments continued to give significant increases over the no manure. The difference between the treatments NP and NK is just significant.

Once again, on Nulltanni, differences between the no manure and treatments are not significant.

Curiously enough, this year, the differences between no manure and the treatments on Kanniamallay Estate are not significant.

Application of complete fertiliser, NPK, has significantly increased the yield over all other treatments on Letchmi.

C. 24 Plot (3 x 8 Randomised Block) Experiment.

Nilgiris: Korakundah. The nitrogen, as ammonium sulphate, was applied during May 1952 and the yield figures to the end of March 1953 are as follows.

TABLE 3.

Nitrogen	0 lbs.	40 lbs.	80 lbs.
Yield	730.9	809.2	786.1 lbs. Made Tea/acre.

Difference required for significance :

P = 0.05 = 133 lbs. Made Tea.

D. 25 Plot (5 x 5 Randomised Block) Experiment.

Nilgiri-Wynaad: Rockwood. The yield data for the year April 1952 to March 1953 are tabulated below.

TABLE 4.

No manure	N	NP	NK	NPK
460	496	501	499	567 lbs. Made Tea per acre

Difference required for significance :

P = 0.05 = 156 lbs. Made Tea.

E. **Soil Amendment Trials**. These trials on Daverashola, Mayfield, and Craigmore Estates were described in the Annual Administration Report—U.P.A.S.I. Scientific Department—1951-52, on page 25.

The application of the corrective amendment mixture to the two areas on Daverashola and Mayfield Estates was made at the end of November 1951, by envelope fork on Daverashola and turnover fork on Mayfield and that of the NPK mixtures during the first fortnight of May 1952, by envelope fork on both estates.

On Craigmore Estate the application of corrective amendment (700 lbs. Rock Phosphate and 100 lbs. 60 % Muriate of Potash per acre) and the first application of the fertiliser mixture (48 lbs. Nitrogen, 24 lbs. Phosphoric acid and 21.75 lbs. Potash) was made in mid-March 1952 and the second application of the fertiliser mixture (40 lbs. Nitrogen, 20 lbs. Phosphoric acid and 18 lbs. Potash) was made during September 1952.

The yield figures from Daverashola and Mayfield Estates are tabulated for 4 different periods, i.e., (1) from the time of application of amendment mixture to the time of application of NPK mixture, (2) for one year after the application of amendment mixture, (3) for one year after the application of NPK mixture and (4) for the whole period from application of amendment mixture to April 1953 and those from Craigmore Estate for one year up to the end of February 1953.

Daverashola

Yield in lbs. Made Tea per acre.

	No Manure.	Ammonium sulphate.	Amend-ment.	NPK	Amendment + NPK.	S. D. P = 0.05
Dec. 1951 May 1952	200.3	200.4	199.2	215.0	216.6	—
Dec. 1951 Nov. 1952	699.3	746.6	671.3	790.8	815.7	91.4
May 1952 April 1953	753.9	845.3	773.4	909.6	910.5	113.9
Dec. 1951 April 1953	895.7	986.9	911.5	1064.9	1069.7	132.7

Mayfield

	No Manure.	Ammonium Sulphate.	Amend-ment	NPK	Amendment + NPK	S. D. P 0.05
Dec. 1951 May 1952	92.6	...	93.6	96.6	103.5	...
Dec. 1951 Nov. 1952	400.4	...	377.2	442.0	475.3	50.9
May 1952 April 1953	483.8	...	465.7	575.7	603.8	62.7
Dec. 1951 April 1953	545.3	...	526.9	638.5	672 3	68.4

Craigmore

March 1952 Feb. 1953	663.3	...	653.9	763.0	751.1	40.7

The results obtained so far indicate:

(a) There has been no effect of the amendment alone on yields. The difference between no manure and amendment only is in no case significant.

(b) The application of an NPK mixture, either alone or together with amendment, has resulted in a significant increase in yield over the control.

(c) The difference in yield between the two treatments, NPK and NPK + Amendment, is not significant, indicating that the application of the amend-

ment mixture either before or with the NPK mixture has so far had no effect on the yield. The addition of amendment has neither increased nor decreased the yield significantly.

It is interesting to note that the results are precisely similar on all the three estates.

(d) On Daverashola the application of ammonium sulphate only at 60 lbs. N/acre has increased the yield over the control, but not significantly.

It must be emphasised, however, that no conclusion can yet be drawn from this series of experiments, which have been running for only a short period.

F. Manuring of Young Tea

The manures were applied in September 1952 and the records of girth of stem, height of plant and number of side branches are being maintained.

Acknowledgements

Thanks are due to Managers of estates visited for assistance received and to Mr. V. Raman who gave very valuable help during the course of chemical analysis of samples and satistical analysis of yield data.

V. Jayaraman,
Soil Chemist.

Report of the Botanist

1952—1953.

General

Technical enquiries dealt with during the year pertained to various botanical and phytopathological aspects of tea, coffee, rubber, shade and green manure plants. Advisory work continued to occupy the greater part of the time and it naturally did not leave as much opportunity as one would wish for research of a fundamental nature. The Botanist contributed a paper entitled "Some aspects of the work of the Botanical Section of the Tea Experiment Station" to the First Annual Conference of the U. P. A. S. I. Scientific Department.

Tea

Leaf Diseases

With the exception of Blister Blight (*Exobasidium vexans*) no disease was abnormally prominent during the period under review. A few leaf specimens of jungle plants showing 'blisters' simulating that caused by the tea Blister Blight organism were received from some estates, but none of them was found infected by *E. vexans*. The fungus commonly found associated with 'blisters' on the leaves of *Gordonia obtusa* was identified as *E. nilagiricum*, which closely resembled *E. vexans* in gross morphological characters. It has been reported that *E. nilagiricum* does not pass on to tea (*Proc. Indian Acad. Sci.*, Sect. B, *29* (1949) : 5-11).

Blister Blight Experiments

1. *Pruning & Protection Trial :* I co-operated in this trial, details of which are presented elsewhere.

2. *Control by Spraying and Dusting.—Demonstration Plots*: During a visit to Central Travancore, I assisted in setting up the demonstration plots on Arnakal Estate, Vandiperiyar.

Stem Diseases

Branch canker caused by the fungus *Macrophoma theicola* was reported from many estates. The fungus can cause considerable damage especially to young plants in new clearings, and in one instance the death of many plants was traced to infection by this organism.

A species of *Diatrype* was found associated with die-back of tea branches reported from an estate on the Nilgiris, but it is not yet established whether the fungus is the primary cause of the trouble experienced.

Red Rust (*Cephaleuros parasiticus*) : The disease continued to be observed in Travancore. Several estates in Central Travancore and Mundakayam were visited in May 1952 with a view to gain some firsthand information on the disease as it occurs in South India. Various factors such as inadequate shade, improper drainage and soil aeration, drought or insufficient moisture, and lack of manure which contribute to the weakness of the bushes are also said to predispose them to severe attacks of Red Rust. These factors were investigated as far as possible and the observations made are, in brief, as follows :

(i) The attacks were more prominent and of greater severity on weak or debilitated bushes than on apparently healthy ones. Bushes infected with such pathogenic fungi as *Macrophoma theicola*, the branch canker fungus, and *Corticium invisum*, the Black Rot organism, also showed heavy infection of Red Rust.

(ii) The attacks were more prominent on bushes in unshaded areas than in shaded ones.

(iii) The damage caused was seen to be severe in areas with a tendency to water-logging. Similarly, in a particular field on an estate, it was more severe towards the very top, where drought damage was marked, than on other parts of the hill-slope.

(iv) The disease was found on almost all fields, even on those manured with a basic application of 20 lbs. per acre of both phosphoric acid and potash. With the high yields obtained on many of the estates in the district and with increasing amounts of nitrogen applied, it was felt that the amounts of phosphoric acid and potash, in particular potash, applied to the fields could be increased correspondingly, the minimum amount suggested for potash being 3.5 lbs. per 100 lbs. of made tea.

The algal parasite was formerly noticed on odd tea bushes in and around the Tea Experiment Station, but during the last year several unthrifty bushes showed Red Rust infection to a greater extent. The severe and continued droughts experienced in the area during the past five years and the consequent debility of the bushes are possibly responsible for the increased intensity of attack by this alga. A preliminary observation made on bushes in the plots of a manurial experiment at the Station showed that, in general, bushes in plots receiving no application of potash over several years were more susceptible to infection by the alga than those in plots receiving an annual application of 40 lbs. K_2O per acre. For example, 64.8 per cent. of bushes in a 'no potash' plot were infected to a greater or lesser extent, while the percentage of infection in a plot treated with 40 lbs. K_2O was only 1.3.

The most important method of keeping Red Rust in check is by maintaining the bushes in good vigour. Naturally, therefore, attention has to be paid to all cultural practices. A direct method of controlling the parasite, however, is essential to check the build up of the disease. This can be achieved by spraying the affected bushes with a copper-based fungicide, such as freshly prepared 1% Bordeaux mixture, or any proprietary copper fungicide at the appropriate concentration. Protective measures against Blister Blight can be expected to check the algal growth only to a small extent, as in the case of this stem disease it is necessary to concentrate the spray on the young susceptible stems and on all branches bearing patches of Red Rust. Spraying, therefore, would only really be efficient if undertaken after pruning the bushes. In certain cases, however, this direct treatment may have to be carried out as early as possible without waiting for the pruning time. This may happen when young plants are attacked, or in cases of severe attacks on older tea not due for immediate pruning. In the case of mature tea, it is tentatively suggested that the bushes be sprayed once immediately after pruning and for a second time at the time of maximum spore production, namely April/May, particular care being taken to wet all green wood formed after pruning. In new clearings and in young tea also, two applications of spray, one in March/April and the second in early May, are recommended. It is emphasized that the young plants are to be sprayed thoroughly, so as to prevent new infections taking place at the time of maximum spore production.

The alga was also noticed on the following plants: *Albizzia moluccana, Bixa orellana, Calliandra brevipes, Erythrina lithosperma, Grevillea robusta Rhododendron indicum* and *Tephrosia candida.*

Root Diseases

Specimens of root diseases were received from several estates in different tea districts and there was evidence from many of them that frequently there has been too long a delay in dealing with infected bushes. The longer the diseased bushes are left in the field, the greater the chance of the disease spreading to neighbouring healthy ones and it is once again emphasized that total elimation of infectious material from the soil is the only reliable method of checking the spread of these diseases.

Red Root disease (*Poria hypolateritia*), Charcoal Stump Rot (*Ustulina deusta*) and Brown Root Disease (*Fomes noxius*) were the ones commonly found, and Black Root Rot caused by *Rosellinia arcuata* was also reported from a few estates.

The first three diseases arise from establishment of contact between a living root of a tea bush and a piece of infected dead wood in the soil. These fungi require a substantial 'food base' before they can overcome the resistance offered by the healthy root of a bush and invade the living root tissue. Fairly thick infected root portions serve as sufficient 'food bases'. In the case of *Poria*, the fungus is capable of spreading freely through the soil by means of rhizomorphs, but the initial 'food-base' is none the less important. Once a living root has been invaded, the organism can gradually spread throughout the entire root system and in a tea field where the roots of neighbouring bushes are closely interwoven, the disease can easily progress from bush to bush. The spread of the disease is often slow and it can be effectively checked if control measures are undertaken as soon as the disease is first noticed. In the control of these diseases, as has been already mentioned, the first essential is the elimination of the source of infection, which in most cases can be traced along the diseased root to a buried dead root or stump All dead and diseased tissues should be burnt and care taken not to scatter infective material in the field. if and when the diseased plant parts are removed outside the field for destruction.

In the case of Black Rot caused by *Rosellinia arcuata*, one additional measure is essential, namely, the removal of mulch around the dead bush and to a distance of about 4 or 5 bushes. This is essential because the fungus can thrive on mulch and spread through it.

Cylindrocladium Disease: Inoculation tests made on mature tea bushes at the Station, on soil conditions entirely different from those associated with the field where the disease was first observed, proved a failure. However, the fungus was found to be pathogenic to potted tea seedlings.

Soil Moisture

Soil moisture determinations continued to be made in the shaded and unshaded areas of a tea field at the Station and the data obtained are as follows :—

Dates.	Percentage of moisture on dry weight basis.				Rain during the previous fortnight (in inches.)
	Shaded		Unshaded		
	9″	18″	9″	18″	
12th September 1952	32.5	30.1	21.1	20.7	1.89
26th ,, ,,	26.1	26.0	22.5	22.0	0.99
10th October ,,	33.2	31.8	26.0	27.2	8.60
24th ,, ,,	32.6	32.4	22.1	23.4	2.15
7th November ,,	26.3	27.9	18.0	21.2	0.34
29th ,, ,,	21.1	22.2	15.3	16.5	...
15th December ,,	22.8	21.2	16.5	16.6	1.38
31st ,, ,.	17.1	19.4	12.4	16.4	...
15th January 1953	14.9	18.5	11.1	15.4	...
2nd February ,,	13.7	19.5	11.1	14.7	...
16th ,, ,,	11.1	15.1	9.5	14.5	...
3rd March ,,	13.3	17.1	9.6	14.2	...
18th ,, ,,	12.5	15.5	8.6	13.4	...

It was once again observed that the soil moisture level in the shaded area was in general higher than that in the unshaded one.

Two interesting points arise out of these observations, namely (i) initial difference in moisture levels in the two areas even as early as September, i. e., in the midst of the monsoon when the soil can be expected to be thoroughly wetted, and (ii) higher moisture content of the soil in the shaded area in March, after a prolonged drought, in spite of the actively growing shade trees. The probable reasons for these interesting features are (i) increases in the organic matter content of the shaded soil brought about by addition of loppings over the course of several years and the consequent increase in the water retentive capacity of the soil, and possibly (ii) the direct effect of shade.

The organic matter content of the soil in both the shaded and unshaded area was determined and preliminary laboratory determinations were also made of the water-holding capacity of these soils. The data are presented in the following table:

	Shaded		Unshaded	
	9″	18″	9″	18″
*Organic matter (%)	3.06	2.13	2.00	1.49
Water-holding capacity (%)	56.28	53.99	48.79	46.75

*Average of 15 determinations.

The increase in organic matter content of the shaded soil is probably responsible for the higher rentention of water in that soil.

Effect of seed dressings on tea seed germination

During the year a small seed nursery was established at Devarshola and opportunity was taken to investigate on a field-scale the effect of applications of certain seed dressings to tea seed, earlier experiments having indicated that the use of these materials significantly accelerated germination of tea seed, ("The effect of seed dressings on the rate of germination of tea seed". P. de Jong, *Plant. Chron.* Vol. XLVII No. 8).

The effect of the following fungicidal seed dressings on the germination of tea seed was studied:

(i) Agrosan G. N. — an organo-mercurial seed dressing containing 1% organically combined mercury.

(ii) Fernasan — an organic non-mercurial dressing containing Tetra- methyl-thiuram-disulphide (TMTD), and

(iii) Tillex — a mercurial preparation containing 1.5% mercury.

The seed dressings were used at the rate of 4 oz. of the dressing per 1 cwt. of seed. The treated and untreated control seeds were put out for germination in the usual way. The following table presents a summary of the results secured.

Treatment.	% Germination in the							
	1st	2nd	3rd	4th	5th	6th	7th	8th week.
Control ...		10	10	15	18	19	9	5
Agrosan G. N. ...		13	10	14	19	20	7	6
Fernasan ...		17	11	19	19	16	4	2
Tillex ...		21	20	21	15	13	2	1

Seed treated with Fernasan and Tillex germinated more rapidly than the untreated control or that treated with Agrosan G.N. For example, in the first four weeks, the germination figures were, 35, 37, 47 and 62% for the Control, Agrosan, Fernasan and Tillex-treated seed respectively. These data are in general agreement with the observations made on a previous occasion (*loc. cit.*) The later development of the plants was not influenced, however, by any of the treatments.

Effect of TCA weed-killer on young Tea Plants

Sodium TCA weed-killer at the rate of 50 lbs. and 100 lbs. per acre showed promise of keeping grass under control. An application in a pruned tea field checked the growth of grass to a considerable extent and no ill-effect was observed on the pruned bushes. It was not, however, known what its effect would be, should it be necessary to repeat the application of the weed-killer.

A preliminary trial was undertaken, therefore, with one year old potted tea plants. TCA was applied to the soil at the rates of 50, 100 and 150 lbs. per acre. No symptoms of toxicity were observed one month after application of the weed-killer in the case of plants growing in soils treated with 50 and 100 lbs. per acre. However, in the case of the highest dosage, namely 150 lbs., yellowing of the foliage was noticed and three months after treatment scorching of the leaf blades occurred. Similar symptoms of toxicity began to be observed on plants in the 100 lbs. treatment three months after application of the weed-killer, while in the 50 lbs. treatment no such symptom was seen. It has yet to be determined what the effect would be of a repeated application of TCA at the rate of 50 lbs. per acre.

Miscellaneous

Green Manures

Damping off of seedlings of *Tephrosia vogelii* caused by a species of *Fusarium* was reported from an estate on the Nilgiris. *Fomes noxius*, the fungus responsible for the Brown Root Disease of Tea, was found to infect mature plants of *Tephrosia vogelii* on another estate.

Seed of a few species of green-manure plants was obtained with a view to maintain a living collection of various green manure plants on the Station. Materials were also gathered of some of the common Crotalarias in order to prepare a descriptive account of the different species. The first of the series, a note on *Crotalaria anagyroides* was completed.

Coffee

The following coffee diseases were recorded from the Nilgiri-Wynaad:

(i) Cankers on the stems of young plants. A fungus, a species of *Ceratostomella*,was found associated with the diseased parts.

(ii) Root Rot of young plants brought about by the fungus *Rosellinia bunodes*.

(iii) Wilting of plants due to infection by a species of *Fusarium*, and

(iv) Brown Eye-spot disease of nursery plants caused by *Cercospora coffeicola*.

Acknowledgements

Thanks are due to Managers of Estates visited for all the help and hospitality received. Assistance derived from various other sources is also greatly appreciated and gratefully acknowledged.

K. S. Venkataramani,
Botanist.

APPENDIX I

Monthly Crop Statement in lbs. green leaf.

(TEA EXPERIMENT STATION, DEVARSHOLA)

	1949/1950	1950/1951	1951/1952	1952/1953
April	3,544	2,016	2,681	3,662
May	6,098	1,678	11,323	4,358
June	5,005	2,238	6,482	6,875
July	7,291	9,994	7,567	6,048
August	5,887	3,843	6,222	10,134
September	4,546	4,611	7,442	4,837
October	5,566	4,635	8,782	10,662
November	4,393	4,867	5,237	3,527
December	2,113	2,875	2,399	3,279
January	1,434	2,846	2,593	2,240
February	1,615	1,839	2,495	1,711
March	2,312	1,882	3,450	1,705
	49,804	43,324	66,673	59,038

APPENDIX II.

List of Publications of the Scientific Dept., for the year 1952-1953.

1. "The Effect of Seed Dressings on the Rate of Germination of Tea Seed", by Peter de Jong. *(Planters Chronicle* Vol. XLVII, No. 7. pp. 177-181*)*.

2. "The Soil of the State", by Peter de Jong. *(Planters Chronicle* Vol. XLVII, Nos 8, 9 & 10. Three parts*)*.

3. "The Care & Maintenance of Crop Protection Equipment", by Peter de Jong. *(Planters Chronicle* Vol. XLVIII, No. 3*)*.

4. "Tea Pests & Diseases and Their Control—A Review", by Peter de Jong. *(Planters Chronicle* Vol. XLVIII, No. 3*)*.

5. Scientific Department, Bulletin No. 11.

APPENDIX III.

List of Tours by Officers of the Scientific Department.

April 1952.	*Chief Scientific Officer.*	Anamallais P. A.
May 1952.	*Asst. Scientific Officer & Botanist.*	C. Travancore & Mundakayam P. As.
August 1952.	*Asst. Scientific Officer.*	South Travancore P. A.
October 1952.	*Chief Scientific Officer*	Anamallais & C. Travancore P. As.
November 1952.	*Asst. Scientific Officer.*	High Wavys Gp., C. Travancore P. A., Singampatti Gp.
February 1953.	*Chief Scientific Officer.*	Kanan Devan P. A.